

Chelonian Wound Care Wetlab Helpful Hints, Terry M. Norton, DVM, Diplomate ACZM, Georgia Sea Turtle Center

Wounds should be thoroughly cleaned and debrided prior to topical medications being placed on them. Varying sizes of curettes, ronguers, and dental instruments can be helpful in debridement of shell wounds. Saline, dilute betadine or chlorhexidine followed by saline can be used to cleanse the wound prior to placing topical medication. Dry the wound thoroughly prior to placing the topical medication.

Products commonly used

Silver containing materials

- 1) 1% silver sulfadiazine cream (Webster Veterinary Product name: Thermazene Company: Kendall)

Use: good for most shell and skin wounds. Difficult to remove from some wounds so not the best choice for deep pockets or fractured shell edges. Mix with Ilex cream (human diaper rash medication, address) which stays on in aquatic environments better.

- 2) Silversorb gel (Medline Product name: silver antimicrobial wound gel sustained release Company: Medline)

Use: Similar use as SSD cream but does not stick to tissue and is more water soluble so easier to remove when cleaning and debriding wounds regularly. Does not stay on wound long in aquatic environments unless waterproof bandage placed.

- 3) Alginate/CMC dressings with antimicrobial silver (Medline Product name: Maxorb Extra Ag+ ReliaMed, Ft Worth TX 76106, 1-800-409-2848). Typically used for moderately to heavily exudating wounds. The material is saturated with sterile water (not saline) and then placed on the wound. We have used in a variety of situations from deep pockets to edges of shell fractures/wounds.

- 4) Silver Mesh (Webster Product name: Silverlon Company: Nich Marketers, Inc. 1-800-943-6424). This product need to be saturated with sterile water as well. We use this on the surface of the wound when we are doing VAC therapy.

Honey/honey comb and Medi-honey calcium alginate dressing with active leptosermum honey (Derma Sciences Product: MediHoney Company: www.dermasciences.com)

Use: Medi-honey is expensive but can be cut up into pieces for smaller wounds.

Reserve use for open coelomic cavity wounds, deep fractures. Honey and honey comb can be used on a variety of wounds. Honey comb is great for packing into wounds and can be impregnated with honey. We obtain honey and honey comb from local bee keepers. A contaminant free source of honey is ideal but not easy to obtain.

Doxirobe Gel (long acting doxycycline at very high concentrations at the site of application, Webster Product: Doxirobe Gel Company: Pfizer): This product has been very useful in treating superficial and deep shell wounds and shell fractures. It provides protection to the wound and stays on very well in an aquatic environment. The primary draw back is that it is expensive and is packaged in very small quantities. Does not heat up or smell when mixed.

Bone cement impregnated with gentomycin, Webster Product: C-ment 1 J-912 bone cement medium viscosity Company: Jorgensen Laboratories Inc. Similar benefits as doxirobe. Product heats up and has a strong odor when mixed. One can vary the thickness depending on the type of wound you are applying it on. Water can get up under the material so important to change weekly or place a waterproof epoxy on the edges so water does not get in.

Bone cement with choice of antibiotic added such as Amikacin. We have obtained outdated bone cement from orthopedic surgeons in our area and then mixed with amikacin. This mixture is placed directly shell wounds and will stay on for up to a month. Purchasing this product would be cost prohibitive for most wound care in turtles.

Waterproof bandages: clean and debride wound and use your choice of topical medication. Clean outer edges of wounds well with Sureprep wipes (Medline Product: Sureprep No-Sting Alcohol Free, Protective Barrier Wipe Company: Medline) and dry thoroughly. Petroleum impregnated gauze (Medline Product: Xeroform Company: Medline) may be useful as the next layer in some wounds and seems to aid in further waterproofing some wounds. Steristrips (Medline Product: Medi-Strips wound closures Company: Medline) can be used to hold all of this in place if complete bandaging is not desirable. Tape and superglue are used a lot but potential can lead to shell damage if used long term. Tegaderm (Medline Product: Suresite Window transparent film dressing Company: Medline) is the next layer. Superglue is applied to all the edges of the tegaderm. Then water proof tape is used to cover the entire wound. More superglue is applied. Superglue gel is easier to work with on some wounds because it is not as liquid, but it is more expensive. When using superglue on the anterior end of the turtle's shell, it may be better to use tissue glue because there is less odor and is less irritating.

Vacuum assisted wound care VAC

A technique for chelonian wound management

We use the “continuous cycle” for duration of therapy. The target pressure can be anywhere from 125-175mmHg. We have used 200mmHg and had no problems. The intensity is a range starting out at 5-10.

Vacuum-assisted closure

General info

- Used frequently in human medicine
- Creates sub-atmospheric pressure
- Shown to decrease healing time in humans and animal studies
 - Faster healing than wet-to-dry bandages
- In humans, reduces need for surgery
 - Wounds that would otherwise require surgical flap procedure by plastic surgeon

Human wound healing

- VAC therapy preferred for diabetic ulcers
 - Slow healing, poor blood flow

—Used frequently for surgical & traumatic wounds

Mechanism of VAC

- Creates negative pressure, which
 - Removes bacterial contamination
 - Reduces bacterial colonization
 - Removes edema
 - Increases blood flow/perfusion
 - Promotes granulation tissue formation

VAC bandage

Benefits of VAC

- Less labor intensive
 - Bandage changes q 48 hrs up to q 5 days
- Fewer painful bandage changes
- Rapidly resolves infection
- Speeds healing

Disadvantages

- More technically challenging than wet-to-dry bandages
- More expensive
- Loud
- Requires a pump or VAC unit

Indications

- Shell defect
 - “punched in” wounds
 - Bone fragment missing
 - Not amenable to screws & wires
- Chronically infected wounds
- Slow healing wounds
 - Including surgical wounds
- Exposed lung or other tissue

Contraindications

- Very fresh wounds
 - Generally best to wait a few days
- Active hemorrhage
- Dehydration
 - Restore adequate hydration first

Initial presentation

- Wound must be debrided and cleaned
- Appropriate antimicrobial therapy
- Wait a day or so to ensure adequate hemostasis
 - If animal is in shock, may not bleed much on presentation
 - Once rehydrated & resuscitated, increased blood pressure may cause bleeding to recur

When to start VAC therapy

- Wound has been debrided
 - Okay if some contamination remains
- Patient is adequately hydrated
 - AND you can ensure continued hydration
 - Eating well on own
 - Pharyngostomy tube in place
- Analgesics & antimicrobials on board
- Stable patient

How to apply a VAC bandage

- Clean, moist wound is covered with gauze or silver-impregnated material
 - Use sterile water, **not** saline
- Foam is cut to size to fit *inside* wound
 - Should fill the defect
- Tubing is placed inside foam
 - Never directly on tissue!
- Seal with tegaderm (\$\$\$\$)

How to start therapy

- Set pump to desired pressure
 - Recommendations vary
 - In humans use ~100-125 mmHg
 - ~20 cm/H₂O successfully
 - 1 cm/H₂O ≈ 0.75 mmHg
- Ensure adequate analgesia
- When pump is turned on, foam should visibly shrivel up

Troubleshooting

- Most common problem is inadequate seal
- May hear leaks (hisses)

- Check edges and tegaderm around tube
- Check areas around moving body parts
- Can be challenging for wounds in proximity to screws & wires
- Look for sharp bony edges

Maintenance

- Initially, change bandage 48 hours
- Stop immediately at any time if there is fresh blood in the tubing
- Stop if patient seems very painful
 - However, often they appear painful just as the pump is turned on, but seem to settle down after a couple of minutes
 - This is in agreement with humans who report discomfort initially & with intermittent tmt
- When wound contamination is no longer an issue, can increase bandage change intervals
- Amount of fluid produced by wound dictates interval
 - Change “juicy” wounds more often
- Generally increase interval by one day at a time, up to q 5 days

During therapy

- Take advantage of bandage changes to allow patients to soak
- Stop suction, clamp off tubing
- Do not leave VAC bandage on w/o suction for > 2 hours
 - Airtight bandage, w/o negative pressure, wound cannot “breathe”
 - Promotes infection

Other needs during therapy

- Turtles can and should be brought outside with the whole apparatus to sun and/or graze
- Okay to stop suction for 1-2 hours/day if necessary to sun animals
- P-tubes nearly always used to maintain hydration and provide nutrition
 - Generally I give water or ringers daily and food EOD

Monitoring therapy

- Chelonians will form a thick membrane over wound
- This is normal, do not debride if infection not present
- Generally stop therapy when defect is completely covered by thick membrane and no fluid is produced during therapy

Shell fracture repair (try various techniques on the diamondback terrapins provided to you today).

Gopher tortoises and similar sized chelonians:

- The shell and soft tissue around the fixation area should be prepared using a septic technique.
- Once the surgical site is prepared and dried of excess moisture, fixation may take place.
- Some imagination may be needed to piece the shell back together. If there are missing pieces, an open space may be present where the missing piece would fit. Other forms of therapy can be applied to the area e.g. wound vac, honey, etc.
- Missing fragments comprising 30% or more of the total shell area lead to a grave prognosis.
- The first step in stabilization is to place screws that will serve as fixation wire attachment sites.
- Select a drill bit that is slightly smaller than the screw to be used. This will allow for easy placement of the screw and provide a secure hold.
- #6 (1/4 in) Philips head screws can be used on a gopher tortoise sized turtle. Box turtles will need smaller screws. If you are on the Galapagos Islands, you may need some very large screws .
- Attempt to begin the pilot hole for the screw at least 0.5 cm from the edge of the fracture line. This distance from the fracture line will provide proper purchase for the screw.
- When drilling, be careful not to place too much pressure on the drill because you may sink the bit into the coelom and damage internal organs
- Use both hands to stabilize the drill; this will reduce the likelihood of drilling into the coelom.
- Place a piece of tape around the drill bit at 0.30 cm (1/4 in) of depth to act as a guide for drilling depth.
- If the shell is penetrated, this does not cause a problem as long as trauma to internal organs has not taken place.
- If drilling is prolonged, heat from the process may produce necrosis of the tissue. To avoid excess heat from the drill bit, drip sterile saline solution on the bit and surrounding tissue when engaged.
- Once a few screws have been placed, it is time to apply the wire.
- Precut a few pieces of wire (6 inches long, 20-gauge stainless-steel wire). Wrap the wire around one screw head between the screws that cross the wire (like a figure eight), and wrap one end around the second screw head and then wrap the 2 ends around each other.
- The knot should be placed between the 2 screw heads, which allows for the knot to be folded against the shell when completed. At this point, hand-tighten the wire with 2 to 3 twists.
- For a detached shell fragment (fragment attached to the underlying tissue but not attached to the rest of the shell), place screws and wires on all sides of the fragment and then proceed to hand tighten.

- Tighten alternate sides to make even contact with the surrounding shell.
- Some small gaps may not close fully but will heal over time.
- With more severe cases, the entire shell may not become stable until the last few wires have been tightened.
- Once all wires have been tightened, some of the wires may become loose and will need to be retightened. When tightening the wire, you may place 5 to 8 twists on the wire—any more and the wire may snap.
- Do not want to secure the wires too tightly along the fracture margins because this may result in pressure necrosis.
- Once the wire is secure, use side cutters to remove the twisted knot to the level of 4 to 5 twists and use the pliers to bend the remainder of the twist, parallel with the wire and the shell.
- In some cases, it is difficult to flatten the knot against the shell and a bead of epoxy putty can be applied to cover the sharp wire tip.
- Occasionally, depression fractures appear, where a fragment of shell is pushed into the coelomic cavity and may or may not be attached to the surrounding bone. These may be difficult to treat because the surgeon has no access to the fragment for reduction into a normal position. It may be possible to reduce these types of fractures with the following procedure. First, place a few screws in the fragment to act as anchors for lifting wires. Next, using a bone plate or external fixator rod of proper length to act as a bridge, the depression wires are then placed around the screws and then around the bone plate or rod. As the wire is tightened, there will be upward force on the fragment, causing it to elevate into a more normal position. Even if the fragment is not completely reduced, and a depression is still present, the fragment will be more stable and allow the wound to heal.
- As an alternate to wire fixation, some wildlife rehabilitators use zip ties or small hooks used in clothing, attached to plastic grommets glued to the shell, to stabilize fractures. This technique may be an option and will save time while the patient is under anesthesia.
- Healing time is generally similar to that for bone fractures in other species, requiring about 4 to 8 weeks. This time can vary depending on the severity of the fracture and level of stabilization achieved with the fixation. Simple, closed fractures may have complete bone healing in 4 weeks, whereas more severe cases may be 8 weeks or longer.
- In more complicated fractures, a staged removal of the screws and wires over 2 to 3 weeks.
- Radiographs may be helpful, but often do not show callus formation. A better guide to a healed fracture is the stability of the fracture on palpation.